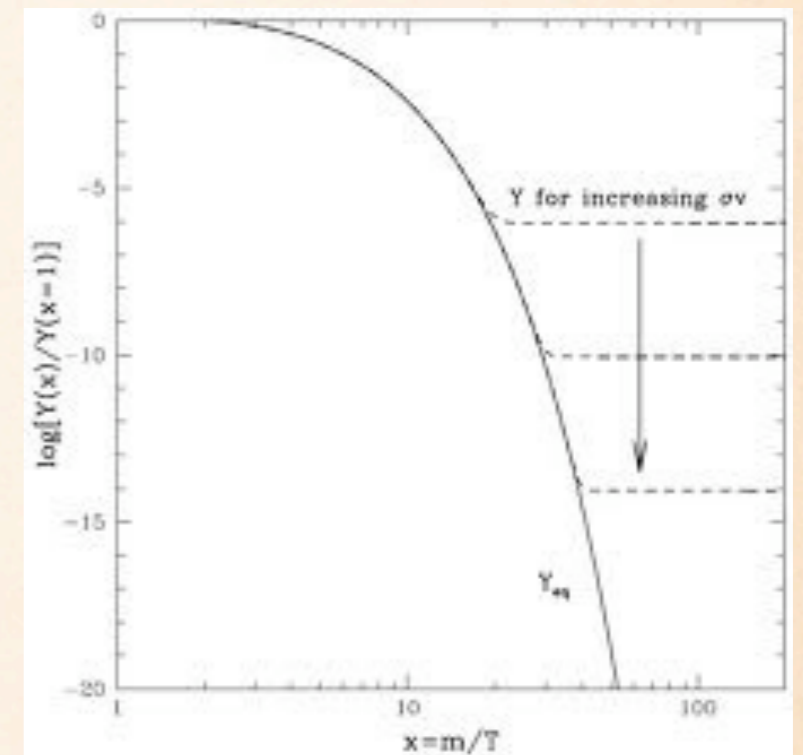


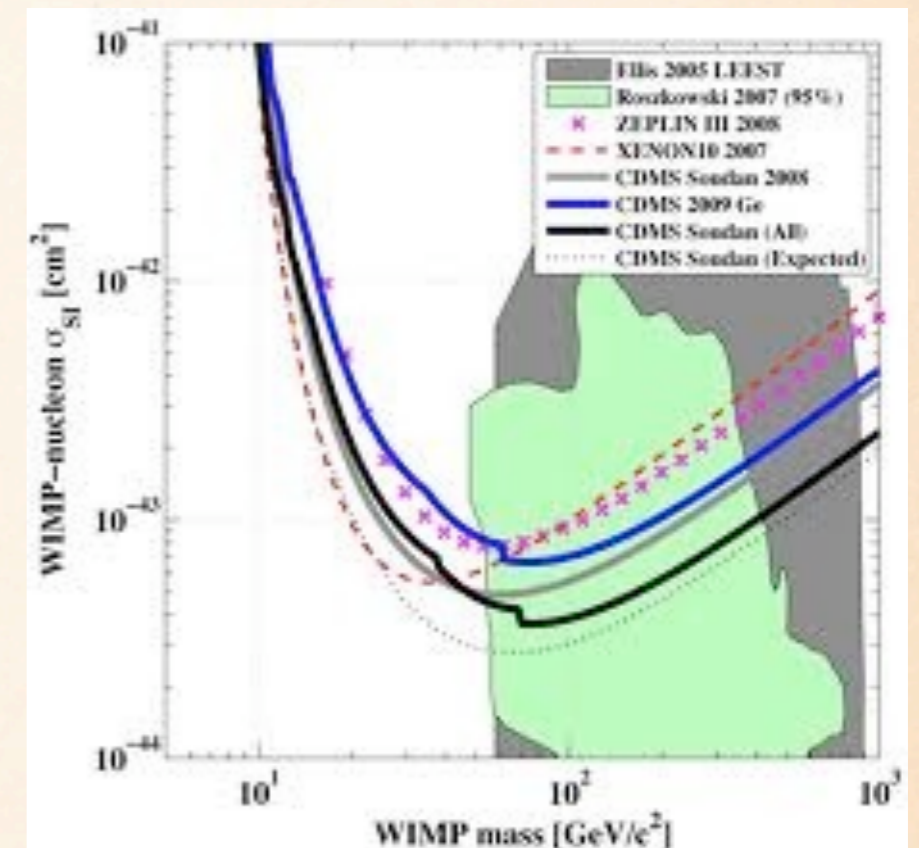
# DM: A STORY

- ❖ In the beginning there was a single, stable, weakly interacting massive particle that
  - ❖ Solved the hierarchy problem
  - ❖ Could evade direct detection bounds
  - ❖ Generated the correct relic density
  - ❖ Made predictions for indirect detection



# DM: A STORY

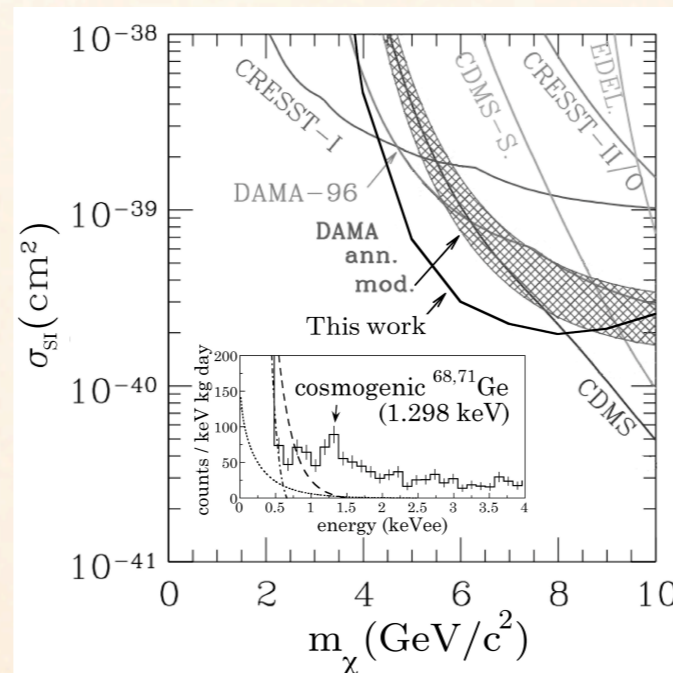
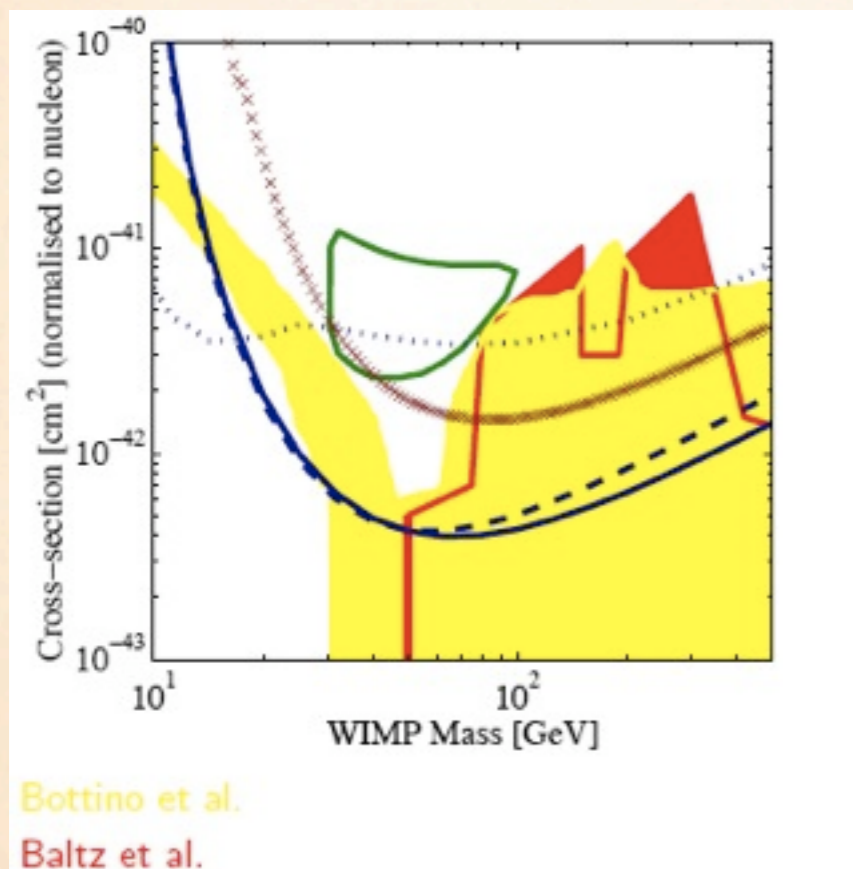
- ❖ Some minor problems:
  - ❖ Direct detection. Scattering cross-section must be sub-weak.
$$\sigma_n \approx 10^{-36} \text{ cm}^2$$
  - ❖ Fine tuning in the MSSM -- why hasn't SUSY been found?
  - ❖ Fix up the problem by extending the model (NMSSM)



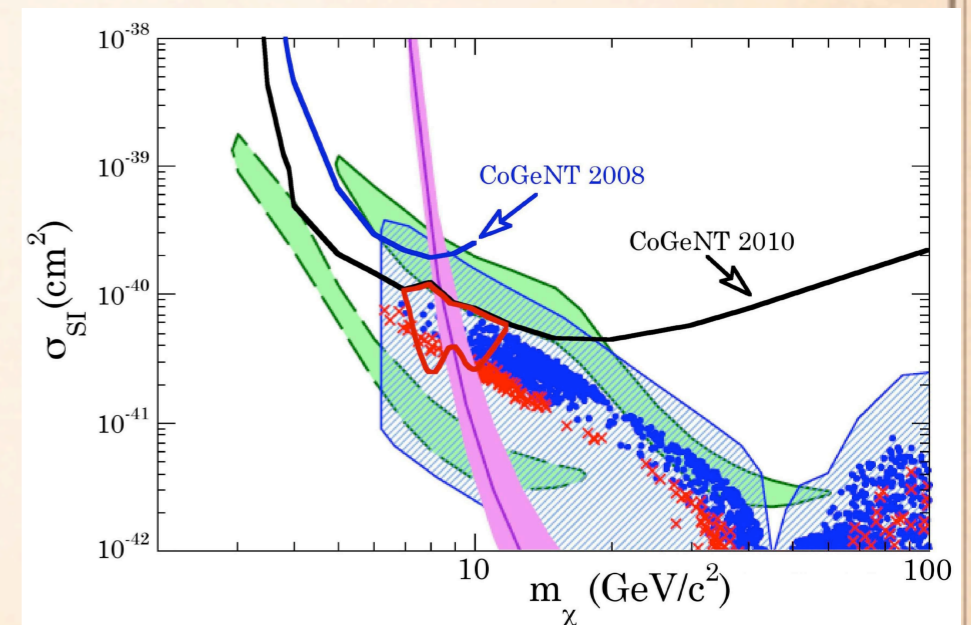
# DM ANOMALIES

- ❖ Predictions of the model mapped onto observed anomalies, neither direct detection nor indirect detection
- ❖ Direct detection: DAMA and CoGeNT

Wait!



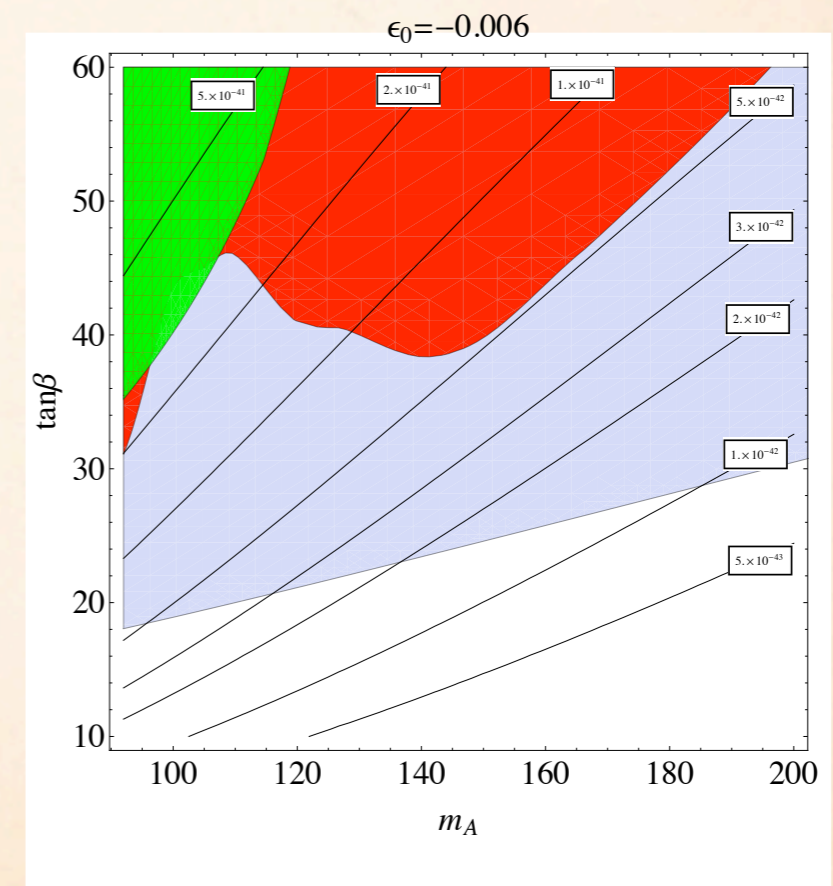
2008



2010

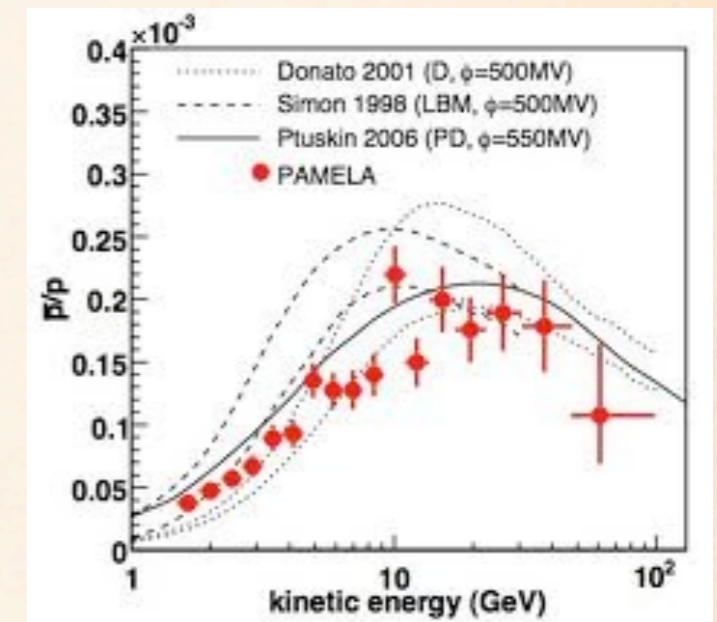
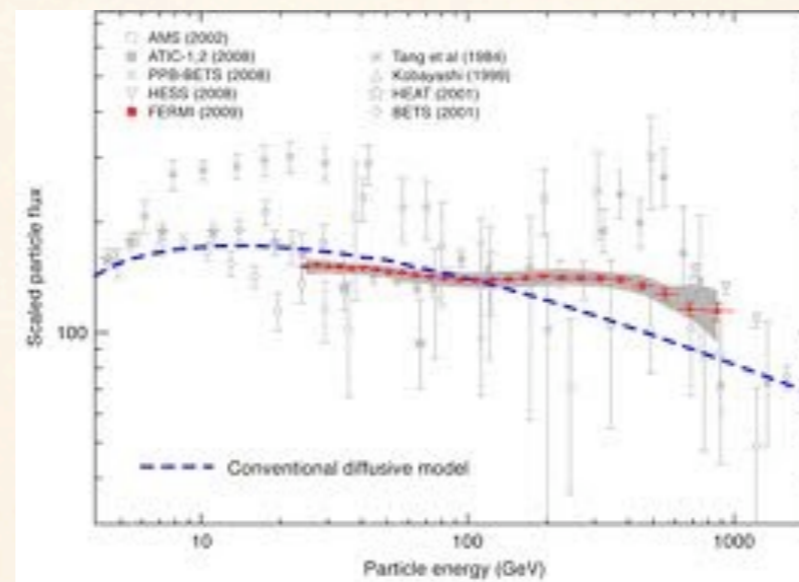
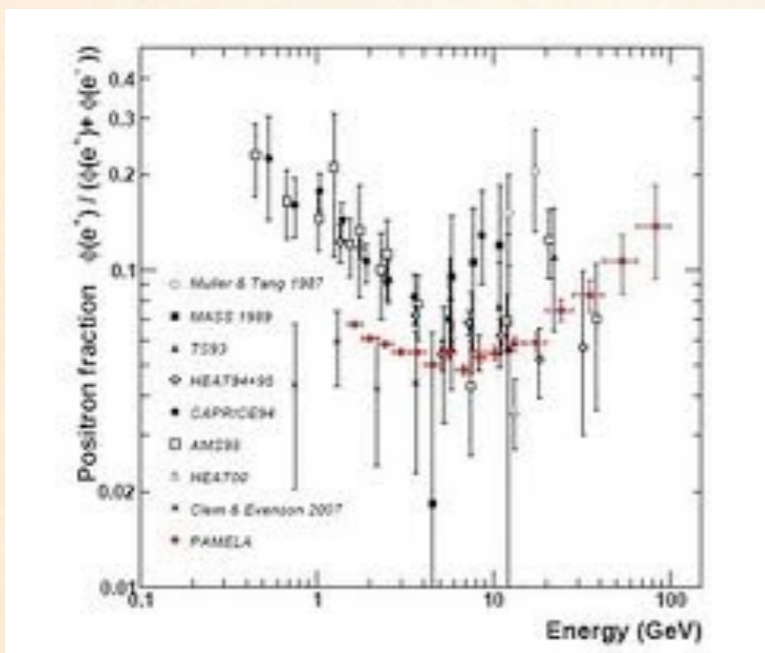
# DM ANOMALIES

- ❖ Predictions of the model mapped onto observed anomalies, neither direct detection nor indirect detection
- ❖ Direct detection: DAMA and CoGeNT



# DM ANOMALIES

## ❖ Indirect detection: PAMELA and Fermi



- ❖ Annihilation cross-section must be big and prefer leptons
- ❖ Neither are single, stable, weakly interacting massive particles

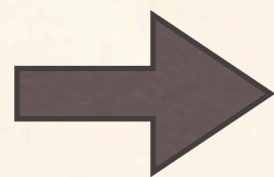
# THEORETICAL IMPLICATIONS

- ❖ All of these signals may turn out to be systematics / astrophysical backgrounds
- ❖ ***But the theoretical landscape has changed***
- ❖ Dark Forces, Low Mass Hidden Sectors, Dark Matter from the Baryon Asymmetry
- ❖ How do our search strategies change in light of the new models and results?

# ASYMMETRIC DARK MATTER

Experimentally,  $\Omega_{DM} \approx 5\Omega_b$

Find mechanism  $n_{DM} \approx n_b$



$m_{DM} \approx 5m_p$

S.M. Barr, D.B. Kaplan

Farrar, Zaharijas

Kitano, Low

Gudnason, Kouvaris, Sannino

Kitano, Murayam, Ratz

$$W = \frac{\overbrace{X^2 LH}^{\text{High scale M}}}{\underbrace{M}_{\text{Electroweak scale}}}$$

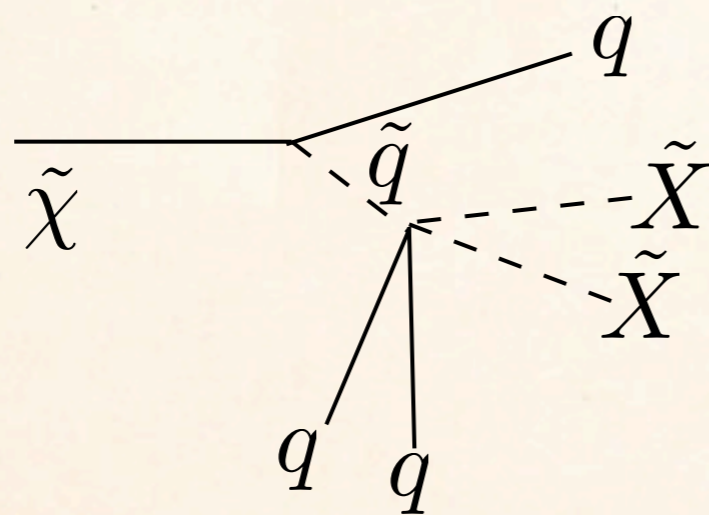
Kaplan, Luty, KZ

Standard Model

X sector

# NEW SIGNATURES

## ❖ Reduce MET



$$W = \frac{X^2 udd}{M^2}$$

$$m_{DM} \simeq 8 \text{ GeV}$$

- ❖ Using gamma telescopes to look below 1 GeV?
- ❖ Pushing the reach of DD below  $m \sim 10 \text{ GeV}$ ?

# THEORETICAL IMPLICATIONS

- ❖ How can we be ready for anything?

